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ABSTRACT

This guide, for use at the secondary level, is designed to create future citizens who will be aware and understanding of their natural environment. Among the subjects discussed are advertising as an ecological cop-out, recycling, optimum environments, hydrophonics, pest control by means of ultrasonic vibrations, the effectiveness of Cottrell Precipitation on controlling smoke pollution, and chemical tests for lead and phosphate pollution. Each learning activity includes behavioral objectives, directions to the teacher and students, lists of materials needed, references, and a listing of related audiovisual materials. (BT)

ED 099215

Laramie County School District Number One

SENIOR HIGH

ENVIRONMENTAL ACTIVITIES

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INTRODUCTION

This guide of environmental activities is one of a series developed by the Eco-Curriculum Development and Learning Laboratory for the Laramie County School District Number One and has been funded by Title III ESEA, Section 306.

Today we are constantly being reminded about the damages that have occurred in our environment as a result of our modern civilization. In Cheyenne, as in communities around the nation we are concerned about the growing need for environmental programs. In Wyoming we are fortunate to be able to enjoy a relatively unspoiled environment. Unlike many other places in our country the environmental programs which we need to develop would be preventative programs rather than remedial programs. We do not (as yet) need to concentrate on repairing and replacing damaged environments, but . . . we do want to enjoy the natural beauty and delicate balances of nature.

Through our schools we have an opportunity to develop a program for our future citizens that would be designed to create an awareness and understanding of our natural environment.

The guide was designed to be used by teachers and students. It is hoped that through its use it will contribute toward a greater appreciation of our environment.

Senior High Submitted by Robert Ball

ADAPTATION OF ORGANISMS TO THEIR ENVIRONMENT

Behavioral Objectives:

1. The student will be able to state that man is more adaptable to his environment than any other organism from a list of ten organisms.
2. The student will be able to explain, without reference, three examples of how the function of living things in their environment is determined by their structures.
3. The studert will be able to define adaptation, without reference, in a manner judged acceptable by the teacher.
4. The student will be able to differentiate between adaptation by structure due to environment, and adaptation to environment due to structure. This will be accomplished without references, and will be judged acceptable by the teacher.
5. The student will be able to correctly categorize fourteen organisms from a list of twenty that have adapted to these four regions: artic, desert, tropical and temperate.
6. The student will be able to briefly explain how three organisms from a list of six have adapted structurally to environment. The explanations will be judged acceptable by the teacher.
7. The student will be able to cite an example of man's adaption to the environment proving that humans can habitate above 15,000 feet mean sea level.
8. The student will be able to display pictures showing adaptation by an organism.

Directions to the teacher:

Define adaptation and discuss with the class the concept that plants and animals must be adapted to live under special conditions or they will not survive.

Distribute a prepared mimeographed sheet listing plants and animals as: polar bear, turtle, Venus's-flytrap, porcupine, angler fish, camel, woodpecker, skunk, squirrel, bat, man, flamingo, lung fish, cactus, electric eel, oppossum, chameleon and others.

Conduct a class discussion concerning how man has changed the environment which has resulted in forcing animals to live in new situations. Elicit from the students examples

of organisms which have successfully adapted, organisms which are extinct, and others which are entitled endangered species.

Suggest that the students prepare a list of ways animals and plants are adapted for cold, arid and light conditions; protections, obtaining food or other adaptations.

Directions to the students:

Answer the following questions about organisms: What peculiar characteristic does each possess? Why does the organism have this characteristic? Has it always had this characteristic? Why don't all organisms living in the same environment have this characteristic?

Find pictures in books or magazines showing examples of organisms adaptation to their environment.

References:

Adapations of Plants and Animals, color, b/w, 14 min
Animals Protect Themselves, color, b/w, 11 min
Camouflage in Nature through Form and Color Matching, color, b/w, 10 min.
Camouflage in Nature through Pattern Matching, color, 11 min.

Derrill, Jacequelyn, Wonders of Animal Migration
Durnett, A. D. and I. Eisner, Animal Adaptation
McNulty, Faith, The Whooping Crane
Morgan, Ann, Field Book of Animals in Winter
Srb, Adrian, M. and D. Wallace, Adaptation
Selsam, Millicent E., Plants that Move
Selsam, Millicent E., The Language of Animals

Senior High

Submitted by Robert Ball

CONTAINED ENVIRONMENT

Behavioral Objectives:

1. The student will be able to name five necessities which man requires to live for long periods of time away from the atmosphere of the earth.
2. The student will be able to demonstrate a way to reconstitute oxygen and carbon dioxide from water on long space flights.
3. The student will be able to cite three examples of science technology adapting items to fit into spacecraft.
4. The student will be able to identify seven items used by man of earth which are by-products of the space program when presented with a list of ten.
5. The student will be able to explain the effects of taking green plants on space trips.
6. The student will be able to select the best two plants for use on space missions when presented with a list of five.
7. The student will be able to differentiate between the closed environment of a space station and the closed environment of a sealab.
8. The student will be able to make a sketch of a contained space environment including a cycle showing how food, oxygen, carbon dioxide, water, wastes, heat, electrical, mechanical, and chemical energy could be re-used.

Directions to the teacher:

The teacher should become familiar with the latest technology used in the skylab and sealab missions. An awareness of the current items used by the astronauts on long voyages as well as the newest methods of reconstituting and recycling of the basic necessities will be needed to conduct class discussions. Information may be obtained by writing to NASA, Houston, TX.

Directions to the students:

The students must spend a good deal of time in preparation by researching the subject as throughly as possible. Current information can be found in the latest

issues of publications and magazines as: Time, Newsweek, U.S. News and World Report. Another source might be the Readers' Guide at the library. This research will be necessary to effectively join in class discussion of contained environment.

References:

Faget, M., Manned Space Flight
Hunter, M. D., Thrust into Space
Stern, P. D., Our Space Environment
Young, R. S., Extraterrestiral Biology

A pamphlet "NASA Facts" is a good source of facts.

Films that might be included:
Space Science - The Planets (survey of nine planets) color, b/w, 16 min.
A Trip to the Planets (surface conditions) color, 15 min.
First Men into Space (solving the space survival problems) color, 16 min.

Senior High

Submitted by Robert Ball

FOG AND ENVIRONMENT

Behavioral Objectives:

1. The student will be able to define fog in a manner acceptable to the teacher without the use of reference.
2. The student will be able to show how fog, a natural phenomona, is a contributing factor to air pollution in industrial areas.
3. The student will be able to briefly explain how ice fog forms and where it usually occurs.
4. The student will be able to list three conditions necessary for the formation of fog.
5. The student will be able to differentiate between fog formed by the cooling process from fog formed by evaporation.
6. The student will be able to correctly categorize four kinds of fog by the process which formed them.
7. The student will be able to cite two factors which cause fog to dissipate.
8. The student will be able to do some outside research to find which major cities in the United States received the most foggy days per year.

Directions to the teacher:

The teacher should review the types of fog and factors concerning formation and dissipation. Introduce the lesson to the class and discuss with them the relationship of fog and air pollution in industrial cities. Point out the differences between smog, smaze and pollution that occurs in temperature inversions.

Directions to the students:

The students should become acquainted with problems encountered with air pollution, especially in and around the major industrial areas of the world. Particular emphasis should be placed on a study of cities where fog forms most often. Current information is available in pamphlets published by the U.S. Government.

References:

Write to the state board of health for materials on air pollution.

The following films may be obtained from Communicable Disease Center:

Sources of Air Pollution, color, 5 min. - USPHS
Effects of Air Pollution, color, 5 min. - USPHS
Control of Air Pollution, color, 5 min. - USPHS
Pollution Over Our Cities, b/w, 15 min. - Net
Breathe at your own Risk, b/w, 58 min.

Additional information may be obtained from your local air pollution control authority.

Senior High

Submitted by Karen Byrne

ADVERTISING AS AN ECOLOGICAL COP-OUT

Behavioral Objectives:

1. The student will be able to write a short paper evaluating the effects of advertising on the environment.
2. The student will be able to write about three different products; one version which will be factual, the other version which will use a persuasive advertising technique.
3. The student will be able to differentiate between factual and persuasive advertising techniques.
4. The student will be able to demonstrate in what ways the advertising is inconsistent with the given situation.
5. The student will be able to find ten actual examples of advertising which are promising results from their product or their environmental efforts which are illogical or impossible.
6. The student will be able to match slogans with a definition of what the advertising is actually promising.
7. The student will be able to define advertising in terms of its effect on people and on the environment.
8. The student will be able to show selectivity in choosing consumer goods and products when confronted with a proposed shopping situation.
9. The student will be able to respond voluntarily about personal experiences concerning the influences of advertising.
10. The student will be able to formulate questions indicating a desire to learn about the inconsistencies of advertising in terms of himself and his environment.

Directions to the teacher:

The teacher should have a large supply of various magazines for this activity. The activity should begin with the students separating into groups to survey the advertising in the magazine. Check sheets should be provided for the student to evaluate the factors involved in each advertisement. Discussion should be permitted in the groups in order that they might argue the various merits and faults of the ads as well as the problems created for the consumer and for the environment. The student should make a notebook about advertising with cut-out ads from magazines; a short explanatory paragraph should be included with each ad. A minimum of ten advertisements should be acceptable. After the student has completed his notebook,

he should write a short paper evaluating the effects of advertising on the environment in terms of needless consumption, status buying, solid waste, the depletion of natural resources, and various types of pollutions created by over-buying.

Directions to the students:

Separate into groups and taking several of the available magazines, discuss the advertising displayed. Using the check sheet as a guide, answer the questions which apply to each ad and discuss any other aspects which relate to the particular ad under study. After the group discussion, begin a notebook in which you pick ten or more advertisements and write a short paragraph about the validity of each one. Then write a paper evaluating what you have learned about advertising and the environment using the catagories given by your teacher to structure your paper.

Materials:

Enough magazines so that each student has one and a question sheet for each student.
Possible check sheet might include: 1) Is the advertising believable? Why? Would you buy the product because of the ad? What are your reasons? 2) Does the ad promise side effects that are logical? Can it actually supply the results that it implies? 3) Does the ad appeal to other characterists that one desires, such as approval or popularity? Is this realistic? 4) If the ad seems concerned with the environment, is it believable? Could you find facts to support their position? 5) Does the ad seem more concerned with the well-being of the buyer than in selling the product? What might motivate this approach? 6) What else do you notice about the ad that might be influential to the buyer? What influences you?

References:

Baker, Samm Sinclair, 1968. Ther Permissable Lie, The Inside Truth about Advertizing. The World Publishing Company, Cleveland, OH

Packard, Vance, 1957. The Hidden Persuaders, David McKay Company, Inc., New Yerk, NY

Senior High Submitted by Karen Byrne

MAN; POETRY; NATURE

Behavioral Objectives:

1. The student will be able to participate in a panel discussion defending the preservation of nature and natural phenomena in terms of man's emotional stability and archetypal needs, using at least three examples of poetry.
2. The student will be able to write a short poem about one aspect of nature which relates to an emotional experience.
3. The student will be able to analyze a poem in terms of the: a) emotional contents; b) the relationship shown between man and nature; c) the universality of the feeling; and, d) the individual response.
4. The students will be able to find at least three poems which convey the emotional connection between man and the environment.
5. The student will be able to explain one connection between the emotions and the environment.
6. The student will be able to define ten emotions with a corresponding metaphor or simile involving nature.
7. The student will be able to cite five examples which illustrate that the emotional relationship between man and nature is important to the pyscholgical well-being of man.
8. The student will be able to react emotionally to the handling of actual objects found in nature, e.g., dirt, rocks, leaves, etc. by writing a short description of the emotional response.

Directions to the teacher:

The teacher should initiate the activity by a general discussion of man and nature as it is portrayed in any of the poems that the students have read. A few poems might be read by the teacher in order to promote ideas. This discussion should emphasize the correlation between man and nature in different facets of man's existence, both historically and emotionally, It should also lead to possible conclusions about the affect of nature on man's creativity. Several books should be available, including collected poems by individual poets and anthologies. The poem that the student writes could be of any form, e.g., haiku, ode, or lyrical as long as it deals with individual emotional response. The class should be formed into groups for the panel discussion and class

time should be given for them to plan their material and presentation. It is helpful if the teacher prepares a panel evaluation chart to be checked during the presentation. The chart should include topics such as clarity, logic, and effectiveness. The chart can be graded by the teacher with the help of the class.

Directions to the students:

Poetry is best understood as an emotional response; using the books available, read the poems in terms of man's connection with nature. Think about your own emotional connection with nature: with which poems are you most sympathetic? Why? Try to read the poems in terms of your own experiences with nature and in terms of how you relate to the correlations presented between man and nature.

It is generally more effective to write about an emotional experience while that experience is still vivid; before writing the poem, remember as much as you can about the details involved. Try to recreate that mood in such a way that the reader becomes involved: use specifics, not generalities. In the group panel discussion, defend your position with specifics; in this case, passages from certain poems could be used to illustrate the emotional involvement and fundamental aesthetic needs which man derives from nature.

Materials:

Several books on poetry are needed. These books should include collected works by poets of various times as well as different anthologies of American and English poetry. The collected poems might include works by W. H. Auden, Wallace Stevens, Walt Whitman, and William Wordsworth. A good poem to use for the initial discussion might be "The Snow Man" by Wallace Stevens:

One must have a mind of winter
To regard the frost and the boughs
Of the pinetrees crusted with snow;

And have been cold a long time
To behold the junipers shagged with ice,
The spruces rough in the distant glitter

Of the January sun; and not to think
Of any misery in the sound of the wind,
In the sound of a few leaves,

Which is the sound of the land
Full of the same wind
That is blowing in the same bare place

For the listener, who listens in the snow,
And, nothing himself, beholds
Nothing that is not there and the nothing that is.

References:

Disch, Robert and others, 1970. The Ecological Conscience, Values for Survival, Prentice-Hall, Inc., Englewood Cliffs, NJ, pp. 194-204.

Stevens, Wallace, 1959. Poems by Wallace Stevens, Vintage Books, New York, NY p. 23.

Senior High Submitted by Karen Byrne

WHAT YOU WRITE IS WHAT YOU LIVE

Behavioral Objectives:

1. The student will be able to list ten possible environmental conditions that will affect man in the future.
2. The student will be able to predict the themes that three of these conditions might have on the writing produced in the future.
3. The student will be able to show five ways in which future conditions will affect the works produced in terms of the correlations between past environments and authors.
4. The student will be able to infer that the environment affects every part of man's existence and it is apparent in the creative works produced at the time.
5. The student will be able to write a short paper about a fictitious author in the future analyzing the work in terms of his environment/or to write a short literary work as though it were produced by a futuristic author.
6. The student will be able to appraise the affect of the future in terms of man's total existence.
7. The student will be able to read selective short stories in order to determine environmental influences.
8. The student will be able to voluntarily find connections between environmental conditions and styles and themes in books which the student has read.

Directions to the teacher:

The teacher should initiate this activity by a general discussion of the environmental factors which influence one's life style and attitudes. This discussion should be predicated on the fact that one's environment relates to every facet of one's existence, including the writing that one does. Some background information would be helpful in determining what the predominate factors might be in the future, e.g., air, water, and noise pollution, over-population, shortage of food, housing or space. A reference shelf containing this information as well as several anthologies of short stories should be available for the student to do the research needed for his "pretend" paper. After the discussion, the student should be told to research future environmental conditions and predict the themes that might result from these conditions.

It will be necessary for the teacher to accept diverse opinions as long as these opinions can be supported logically by factual information. After the research is completed and the student has a frim foundation with which to work, have him write either a critique of an imaginary writer in the future or a short piece of literature by an imaginary writer; both should be accompanied by a short biographical sketch. These papers can either be read before the class or mimeographed and given to each student. The students should appraise each other's works to determine if the environmental factors are consistent with the themes or styles stated.

Directions to the students:

One of the more difficult problems for man is to project his knowledge into the future; to predict what the future will be. However, in terms of what you know about the future, either from newspaper articles, reports, or the information available in class, construct a futuristic environment which is logically correlated to this informatiion. After you have constructed this environment, imagine how such conditions might effect the writing that would be produced. Correlate your environment to this writing in terms of the major problems both physical and psychological that one would face in the future. You may either write a short piece as though it were written by a futuristic writer or a critical analysis of an imaginary work; both should include short biographical sketches and both should be consistent with factors as we now forsee them.

Materials:

Several books should be available which provide information about the future; Future Environments of North America by F. Fraser Darling and The Environment of America, Present, Future, Past by Thomas C. Jones are good resource books. Also several books of short stories should be available so that the student can see the connection between the environment and the literature of the past.

References:

Darling, F. Fraser, 1966. Future Environments of North America, The Natural History Press, Garden City, NY.

Jones, Thomas C., 1971. The Environment of America, Present, Future, Past, J.G. Ferguson Publishing Company, Chicago, IL.

Senior High

Submitted by Jean E. Cooper

COMPARATIVE STUDY OF SEED VIABILITY AND GERMINATION WITHIN A LIMITED TIME AND UNDER STANDARIZED CONDITONS

Behavioral Objectives:

1. The student will be able to compute percentages of viability and germination.
2. The student will be able to recognize the parts of the embryo plant in both monocots and dicots.
3. The student will be able to recognize that various kinds of seed may require different germination periods and conditions.
4. The student will be able to write a paragraph on the importance of seed germination variations to the survival of the species.
5. The student will be able to explain differences in percentage of germination between domestic and wild plants.
6. The student will be able to recognize that dry, dead-appearing seed is actually alive and its viability can be identified by chemical means.
7. The student will be able to follow laboratory instructions efficiently, asking questions about unclear procedures.
8. The student will be able to appreciate the importance of understanding that various seeds have different germination requirements when he attempts to start garden plants from seed.

Directions to the teacher:

At least forty seeds of each of ten varieties should be provided. Students may be asked to provide some of them. Large seeds are best but if stereomicroscopes are available, some students may try small types. Seed from both wild and domestic plants should be available.

The tetrazolium solution must be used within three to six hours of preparation. To prepare the solution, mix 5 grams of tetrazolium with 100 ml of distilled water. Seeds in tetrazolium may be stored overnight in the refrigerator after the initial 25 minute reaction period in darkness. Students should be queried as to the reason for refrigerating the material. If necessary, the principles of enzyme activity may be reviewed before or during the activity.

Directions to the students:

Work in teams of three or four. On the first day, select three seed varieties and soak overnight forty seeds of each kind. On the second day, cut twenty soaked seeds of each kind longitudinally through the embryo, be sure to cut through the hypocotyl. Place one-half of each seed, cut side down, in a dish. Pour enough tetrazolium in each dish to partially cover the seeds. Store the dishes in a dark place for about 25 minutes.

While the seeds are reacting with the chemical, set up a germination roll for each kind of seed being used by your group. Place the seeds along one edge of a wet paper towel. Fold the edge over the seeds to hold in place and prevent exposure to the dry air. Fold the other half up to the first edge and roll. Fasten the roll with a rubber band. Stand the three rolls in a container of water, be sure the seed edge is not in the water. After 25 minutes, count the number of seeds tht turned red in tetrazolium. This indicates that they are viable.

Compute the percentage of viability per seed variety. Every other day for two weeks, check the seed rolls and count the number which have germinated, keeping a continuous record. Remember if a seed sprouted, even if it died later, it must be counted when figuring the percentage of germination.

After fourteen days, check the viability of seeds which did not germinate with tetrazolium.

References:

_____, "Seeds", Carolina Biological Supply Co.

_____, Molecules to Man, BSCS Blue Version, Houghton Mifflin, 2nd Edition, lab. 14.2 and 3rd edition, lab 15A.

Senior High

Submitted by Jean E. Cooper

EFFECT OF TOBACCO SMOKE ON NAVY BEAN SEEDLINGS

Behavioral Objectives:

1. The student will be able to recognize the importance of controls in experiments.
2. The student will be able to learn to design and build the simple necessary equipment.
3. The student will be able to improve his observational skills.
4. The student will be able to predict the effects of heavy tobacco smoke on different kinds of plants.
5. The student will be able to develop appreciation of the basic needs of plants if they are to grow well.
6. The student will be able to recognize that all types of life may be adversely affected by the gases in tobacco smoke.
7. The student will be able to communicate with fellow students on the "why and why not" of smoking tobacco.
8. The student will be able to design and try further experiments to determine directly observable effects of tobacco smoke on organisms.

Directions to the teacher:

Either the teacher or a group of students should plant navy beans before the beginning of the experimentation. There should be an adequate supply of bean seedlings each with at least one pair of true leaves. Groups of students should be assigned to design and build the smoking chamber and the smoking machine. It is suggested that the smoking chamber be of plastic and at least a meter in length on a side.

Two student should inform the principal so that he is aware of the experiment.

Directions to the students:

The smoking chamber should be designed as nearly air tight as possible when in use but capable of being opened at night to expose the plants to unpolluted air. Equal numbers of experimental and control plants should be available. The control plants should be kept as the same temperature and under the same light as the experimental plants.

Ten to twenty standard length, unfiltered cigarettes should be smoked in the smoking machine per five hour school day. This should be done for at least five days. Open the smoking chamber one hour after the last cigarette has been smoked each day and leave it open until the next smoking day. If time permits additional runs may be made using filtered and king-sized cigarettes.

References:

"Effects of Air Pollution on Ornamental Plants", USDA Slide Set.

_____, Smoking and Health Experiments, Demonstrations, and Exhibits, #1843, Public Health Service

_____, Chart Book of Smoking, Tobacco and Health, #1937, Public Health Service.

Senior High

Submitted by Jean E. Cooper

MICROORGANISMS ASSOCIATED WITH A "PAD" OF FLOATING GREEN ALGAE

Behavioral Objectives:

1. The student will be able to increase his speed and efficiency in using the compound microscope.
2. The student will be able to learn to identify water organisms.
3. The student will be able to learn the importance in controlling the factors which might affect an experimental set-up.
4. The student will be able to recognize the complexity of the energy relationships within an ecosystem.
5. The student will be able to explain the relationships of various water organisms to a specific alga and to each other.
6. The student will be able to discriminate between stagnant and productive ponds.
7. The student will be able to predict ways the productive pond may be come stagnant.
8. The student will develop appreciation of the importance of human patience when studying live organisms.

Directions to the teacher:

A field trip to a nearby permanent pond should be planned so student teams may collect "pads" of filamentous green algae. A grass rake works well for taking the "pads" and the team should obtain approximately 10 cm in diameter of algae. The "pads" should be drained (a kitchen strainer works well) and placed in approximately three liters of ccoled, sterile tap water.

The students should make slides of some of the material the day it is collected. The study should run at least five consecutive days. The materials will keep much longer.

Directions to the students:

Each day beginning with the day the materials are obtained, prepare and study at least ten slides. Record sketches of each new type of organism that appears. Note when the new organism appeared and the numbers involved. Identify by common name and as much as possible by scientific name. Be prepared to discuss why the numbers and kinds

of organisms changed and why sterile tap water was used as a growing medium rather than pond water. Be prepared to write a paragraph explaining the difference between a stagnate and a productive pond.

References:

Eddy Samuel and A. C. Hodson, Taxonomic Keys to the Common Animals of the North Central States, Burgess Publishing Co., Minneapolis, MN

Needham, James A. and Paul Needham, 1962, A Guide to the Study of Fresh-Water Biology, Holden-Day, Inc., San Francisco, CA, paperback

Any modern general biology text

Senior High Submitted by Curtis Grandstaff

COMPARING WOOD AND ITS SUBSTITUTES

Behavioral Objectives:

1. The student will be able to name three working qualities of wood.
2. The student will be able to name three working qualities of metal.
3. The student will be able to name three working qualities of concrete or clay.
4. The student will be able to name three working qualities of plastic.
5. The student will be able to list two limitations of wood, metal, concrete, and plastic.
6. The student will be able to predict the success and limitation of each material when given a simple functional design to be constructed.
7. The student will be able to re-design the simple functional item to accommodate each material and still serve the original purpose of the object.
8. The student will be able to "discover" a new constructional material and show its usefulness.

Directions to the teacher:

Discuss these four types of construction materials, presenting the advantages and limitations of each. Help students to use foresight to recognize future limitations of products. Students should be encouraged to recognize potential of recycled materials.

Directions to the students:

The student will obtain a type of material other than the four used for the class presentation. The student will design and construct a function item using the "new" material. All procedures and results should be recorded.

Materials:

Four types of materials for class presentation. Small notebooks for recording and a "new" material sample.

Senior High Submitted by Curtis Grandstaff

PROJECTS FROM LEATHER SCRAPS

Behavioral Objectives:

1. The student will be able to design a small usable garment incorporating scraps of leather from a ready-made garment.
2. The student will be able to draw patterns for cutting the leather.
3. The student will be able to plan the amount and types of materials needed to complete the project.
4. The student will be able to lay out the pattern on the leather scraps in the most economical manner.
5. The student will be able to cut designs from the leather.
6. The student will be able to position the leather designs onto the garment and secure them with pins.
7. The student will be able to attach the leather to the fabric by using glue, a zig-zag stitch on a sewing machine, or an overcast stitch with yarn by hand to complete the project.
8. The student will be able to write a brief description of products and procedures used in his project.

Directions to the teacher:

Obtain scraps of soft leather, colored suede, and chamois skins. Display pictures of suggested projects. Teach students to plan before each move to avoid waste. Encourage students to be creative in their designs and to renovate old garments with the leather.

Suggest that other items besides clothing can be produced in this assignment using leather scraps and ready-made products. Suggestions might include: patchwork afgans, appliqued pollows, tote bags, purses, belts, gloves, and jewelry. Emphasize the utility of these low cost attractive projects.

Directions to the students:

Obtain a ready-made garment or another applicable ready-made item. Design and construct a functional item by affixing leather to the ready-made item. Then arrange the finished project and brief description for display.

Materials:

Soft leather, colored suede, chamois skins, glue, yarn, zig-zag sewing machine, pins, scissors, pictures of examples and garment for each student.

Senior High

Submitted by Curtis Grandstaff

RECYCLING BY REFINISHING

Behavioral Objectives:

1. The student will be able to prepare a wood surface.
2. The student will be able to choose proper color relationships.
3. The student will become aware of the elements for the drying process.
4. The student will be able to apply sealers and penetrating oils.
5. The student will be able to apply stains and wood fillers and know the proper places to use them.
6. The student will be able to use sandpaper, steelwool and other supplies.
7. The student will be able to choose the proper brush for each procedure.
8. The student will be able to apply a finish by spraying.
9. The student will be able to display a finished product.

Directions to the teacher:

Obtain necessary supplies for demonstration of each objective. Emphasize the value of reclaiming old furniture through refinishing.

Directions to the students:

Choose a small item to be refinished. Assess the item and decide upon the best process for that project. Apply the necessary steps to refinish the item. The end result should be a usable product from a discarded item.

Materials:

Standard wood shop materials and equipment a discarded item of furniture on which to demonstrate processes. Small item of furniture for each student.

Senior High Submitted by Richard Kean

CONSTRUCTING ECO-DUDES

Behavioral Objectives:

1. The student will be able to define an "ecology-minded person".
2. The student will be able to describe an environmental problem.
3. The student will be able to identify several environmental problems in the community.
4. The student will be able to propose several ways of bringing the problem of littering to the attention of the public.
5. The student will be able to describe the purpose of constructing an "Eco-Dude".
6. The student will be able to assist in the construction of the "Eco-Dudes" and the collection of litter.
7. The student will be able to explain several effects of people becoming aware of the problem.
8. The student will become conscious of his own actions and their effect on the environment.
9. The student will be able to express a desire to solve other environmental problems.

Directions to the teacher:

To construct an "Eco-Dude": take two pieces of wood and make a stick figure; then cover the figure with chicken wire and attach litter that has been collected from the immediate area. Place the "Eco-Dude" in a conspicuous location to draw attention. The teacher should realize that the ultimate success of this activity will rest to some extent on his willingness to spend time outside the regular school day helping students to construct and place "Eco-Dudes". Some thought should also be given as to how the litter will be secured. Suggestions from the students may be of help, buy you should have at least one alternative in mind. If there is any question regarding the legality of placing the "Eco-Dudes", it is recommended you seek permission from the proper authorities.

Directions to the students:

You are to define an "ecology-minded person" and an environmental problem. Identify several environmental problems that exist in your community. Think of different

ways in which you can help the public to become aware of littering. Identify an area where you have noticed an considerable amount of litter. With your classmates, organize and conduct a campaign to make the public aware of littering problems utilizing the "Eco-Dude" and any other means that you think will be effective.

Evaluate the results of your campaign. With this information, decide if there are other environmental problems that need solving in your community. If so, proceed with enthusiasm.

Senior High

Submitted by Richard Kean

ORGANIZING A CAR POOL

Behavioral Objectives:

1. The student will be able to identify several ways to encourage other students to participate in a car pool.
2. The student will be able to particpate in organizing a car pool for fellow students.
3. The student will be able to participate in a car pool if he presently drives or is driven to school.
4. The student will be able to encourage and assist other students in organizing and operating a car pool.
5. The student will be able to identify and display meaningful data in a thoughtful manner.
6. The student will be able to encourage and assist people in other situations to organize car pools.
7. The student will be able to demonstrate an understanding of the value of the car pool.

Directions to the teacher:

The teacher will need to discuss the problems created by automobiles at schools for the students, teachers, and administrators, and also upon the environment. Assist the students in conducting the necessary surveys to determine drivers and where they live. The teacher will need to assist the students in interpreting and displaying data.

Directions to the students:

Identify several problems that are results of students and teachers driving to school. Think of ways to encourage students to participate in car pools. Conduct a survey in your class to determine drivers and where they live. Plot these findings on a map and determine riders. Once this is accomplished, work out the necessary schedules and routes needed to create an effective car pool. Follow through and participate if you are a driver. Collect meaningful data to determine the amount of gas that was used before the organization of the car pools and the amount that is being used now.

Using all data and ideas, attempt to encourage more students to organize car pools. Explain environmentally beneficial results of a successful car pool by speeches, debates, essays, poems, drawings, charts, graphs, etc. Use the knowledge gained from this activity to help others in the community organize car pools.

Materials:

To conduct this activity, one will need maps of the community, poster board for displaying data, and a survey sheet with questions.

The survey sheet might include the following: Name; Address; Telephone number; Do you drive or are you driven to school?; At what time must you arrive at school?; What time do you leave school?; Do you have an after school job?; and/or any other questions that you want to include.

Senior High Submitted by Richard Kean

RECYCLING THE CLASSROOM

Behavioral Objectives:

1. The student will be able to define the word "recycle".
2. The student will be able to identify several classroom items that can be recycled, reused or shared.
3. The student will be able to recycle, reuse, or share classroom materials when it is possible.
4. The student will be able to identify other situations in which objects can be recycled, reused, or shared.
5. The student will be able to identify objects, other than school materials, that can be recycled, reused, or shared.
6. The student will be able to identify ways to encourage others to recycle, reuse, or share items that are used daily.
7. The student will be able to encourage others to recycle reuse, or share objects that they use daily.
8. The student will be able to explain why recycling reusing, or sharing items is important.

Directions to the teacher:

Consider the consquences of recycling, reusing, or sharing materials in the classroom before beginning this activity. Having given this careful consideration, be prepared to discover and use the ideas of the students. This may mean that some additional time will be required to assist the students in encouraging others to recycle, reuse, or share objects.

Directions to the students:

You are to define the word "recycle". Think of things you, your classmates or your teachers use that could be recycled, reused, or shared. Make a point to recycle, reuse, or share those items whenever it is possible. Identify other situations and items that you have observed that could be recycled, reused or shared. Think of ways to encourage people to become aware of saving and then follow through on your ideas. Finally, compose a speech, poem, picture, play, debate, essay, etc., on the importance of recycling, reusing, or sharing of items that are used daily.

Comments:

As a means of evaluation, one might want to keep a record of those students who submit ideas and contribute to the goal of the activity by helping to carry out the

various ideas. One could also evaluate the student's ability to define the word "recycle". Another evaluation could be made by observing the quality of the student's work in whatever he chooses to do to demonstrate his understanding of the importance of recycling, reusing, or sharing items that are used every day

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_____, "Aluminum Recycling Program", Adolph Coors Public Relations, Denver, Colorado

_____, "Glass Recycles", Glass Containers Manufacturers Institute, Inc., New York, NY

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Senior High Submitted by Art Kissack

GERMINATE A MUSHROOM SPORE

Behavioral Objrctives:

1. The student will be able to apply slide preparation techniques to the problem.
2. The student will be able to apply microscopic techniques to the problem.
3. The student will be able to integrate learning from different areas into a plan for solving a problem.
4. The student will be able to develop a hypothesis.
5. The student will become acquainted with problem solving methods.
6. The student will be able to actively participate in trying to germinate a spore.
7. The student will be able to develop an experiment for testing his hypothesis.
8. The student will be able to observe mushroom spores under a microscope.

Directions to the teacher:

This activity is organized so that students must rely on their own devices to solve each step of the activity. The teacher is urged to clarify the assignment. It is hoped that the teacher knows nothing about mushrooms or spore germination. The observation activity should be entirely undirected.

Encourage each student to germinate a spore. Explain that you know nothing about spore germination, but that you do know something about problem solving techniques. Encourage the students to share their ideas and research with peers and with you. Everytime a student asks you to decide his course of action, counter with a question as to the results of trying his suggestions.

Spores are not like seeds because they don't have minature adults inside. Instead, spores will germinate into a fuzzy mass (mycelium) and might not form a mushroom immediately. It is necessary to know if any fuzzy growth is caused by germination of the spores under investigation or represent some unknown contaminant.

Regardless of the ability to germinate a spore, if the students learn a problem solving technique, the entire activity will be a success.

Remind the students of the scientific investigation ideals: isolate one variable, establish a control to compare, and have sufficient numbers for predictable results.

Directions to the students:

This is an activity to observe a mushroom spore. What makes a mushroom spore germinate? Develop a hypothesis about the problem. Perform an experiment to test your hypothesis. Record all procedures and collected data.

Materials:

Mushroom spores, slides and cover slips, microscopes, resource books and general laboratory materials.

Senior High

Submitted by Art Kissack

MAGIC CAN

Behavioral Objectives:

1. The student will be able to develop a hypothesis.
2. The student will be able to apply basic problem solving techniques to a new situation.
3. The student will be able to distinguish a good from a bad hypothesis.
4. The student will be able to devise his own magic can.
5. The student will be able to test predictions.
6. The student will be involved directly in a trial and error learning situation.
7. The student will be able to demonstrate his solution to the problem.
8. The student will be able to propose a hypothesis for further investigation.

Directions to the teacher:

Suspend a weight in the middle of a rubber band that is anchored to each end of a can. When a can is pushed the rubber band will twist, thus creating an equivalent potential energy for the can to return to its original position. The teacher should camouflage the can so that its workings cannot be detected.

Demonstrate the mystical properties of your magic can. Ask the students how it works. Never let anyone open the can. Explain that all problems cannot be solved by looking inside and that there is a way of discovering the contents without opening the can. Do not tell the materials you used. A hypothesis is usually defined as an educated guess. This should be distinguished from a wild guess or one that is uneducated. Encourage students to make their own magic cans.

Directions to the students:

Formulate a hypothesis as to the operation of the can. How would you test this hypothesis? Propose a hypothesis for further investigation.

Materials:

Can with lid; rubberband; bolt and wire

Senior High

Submitted by Art Kissack

OPTIMUM ENVIRONMENT I

Behavioral Objectives:

1. The student will be able to draw his own conclusions about optimum environment from direct experimental data.
2. The student will be able to propose a hypothesis for further investigation.
3. The student will be able to construct a graph from the experimental results.
4. The student will be able to estimate microscopic populations by learning the mechanics of microscopic sampling techniques.
5. The student will be able to judge the optimum environment for yeast culture (in vitro).
6. The student will receive satisfaction from discovering known facts.
7. The student will be able to make a wet mount slide.
8. The student will be able to apply different variables to the experimental design for further investigation of optimum environment.

Directions to the teacher:

Allow three days for this lab. The first day will allow you to organize the groupings and set up the experiment as well as time to demonstrate and explain the sampling technique that will be used the following day.

After a twenty-four hour incubation period, yeast samples can be taken which will indicate the population density within each tube. The second day will require most of the period. It is essential that all test tubes be completely sampled the same day.

It is the population density measured in numbers of yeast per 100X field that is used to make a graph of the collected data after it has been collected and averaged for each class.

This is a flexible lab that can be accomplished in a variety of groupings from four to eleven individuals.

There are a variety of sizes of yeast grains, therefore, instruct each group to select 22 medium sized grains. This will tend to average out the innoculation error.

Masking tape is used to mark each test tube to eliminate confusion.

Cotton plugs or aluminum foil can be used as stoppers in each tube to prevent contamination.

Directions to the students:

HYPOTHESIS - The amount of nutrient will directly affect the population density of yeast in vitro.

First Day: Prepare the materials following the directions below.

TEST TUBE	A	B	C	D	E	F	G	H	I	J	K
Water in ml	10	9	8	7	6	5	4	3	2	1	0
Syrup in ml	0	1	2	3	4	5	6	7	8	9	10

Select 22 medium-sized yeast grains from the package provided. Place two grains in each tube and mix thoroughly until dissolved. Place all eleven tubes in a container and store in a relatively warm place overnight.

Second Day: Prepare a wet mount slide by placing a drop of well-mixed liquid from the test tube you are sampling. Place a cover slip over this drop by holding it at a 45 degree angle in contact with the slide, moving it until the slip contacts the liquid and then drop it gently over the liquid.

Place the slide under the microscope and focus with the lowest lens. Search the slide for visible yeast cells. If none are found, mix the tube contents again and start over with a clean slide. When yeast are found switch to 100 magnification (standard on most microscopes) and make this field your first count. Then move the slide at random (without looking through the microscope) to two other areas and count the total number of yeast in each field. After making three counts for each tube, add these counts for each tube and divide by three, thus giving you an average number of yeast per 100 magification per tube.

Third Day: Each group should graph its own results. A second graph will be constructed by everyone from the total average of all the groups. Compare the two graphs. Offer explanations as to deviations. From the experimental data, what is the optimum nutrient environment for yeast in vitro? Does the data support the original hypothesis? Propose a hypothesis about another optimum environmental factor which might affect yeast in vitro. From this experiment what conclusions have you drawn with respect to optimum envioronment and living things?

Materials:

Each group will need: eleven test tubes; one test tube rack; one package of dried brewers yeast; one bottle of dark corn syrup; one graduated cylinder; one roll of masking tape; tap water; cotton plugs or aluminum foil, slides and cover slips; four microscopes (minimum) and droppers.

Senior High

Submitted by Art Kissack

OPTIMUM ENVIRONMENT II

Behavioral Objectives:

1. The student will be able to interpret graph data and make predictions as to the optimum environment of yeast in vitro.
2. The student will be able to apply different variables to the experimental design for further investigation of optimum environment.
3. The student will be able to examine experimental data variations with a view for formulating opinions about them.
4. The student will be able to criticize the experimental design.
5. The student will be able to draw his own conclusions about optimum environment from direct experimental data.
6. The student will be able to propose a hypothesis for further investigation.
7. The student will receive the satisfaction of knowing the facts as he discovers them.
8. The student will be able to critique the experimental design.

Directions to the teacher:

Hypothesis: Does alcohol affect population density of yeast in vitro?

Background information on yeast metabolism usually leads into the hypothesis. (Yeast + food = CO_2 + Alcohol + More Yeast)

Invite criticism by asking if this experiment measures data accurately. Compare design to the basic requirements of the scientific method: isolation of one variable; establish a control for comparison; and have sufficient numbers for predictable results.

There appears to be two variables in the experiment: the amount of media and the amount of alcohol.

Experimental design:

TUBE	A	B	C	D	E	F	G	H	I	J	K
MEDIA IN ML	10	9	8	7	6	5	4	3	2	1	0
ALCOHOL IN ML	0	1	2	3	4	5	6	7	8	9	10

Directions to the students:

Graph population densities of all tubes with the alcohol concentration. Propose a hypothesis for further investigation of optimum environment. Compare the experimental design with the basic requirements of the scientific method: isolate one variable; establish a control for comparison; and have sufficient numbers for predictable results and identify how these requirements are accomplished in this activity.

Materials:

Test tubes; test tube rack; dried brewers yeast; dark corn syrup, graduated cylinder; masking tape; ethyl alcohol; eye droppers; slides and cover slips; and microscopes.

Senior High Submitted by Art Kissack

OPTIMUM ENVIRONMENT III

Behavioral Objecitves:

1. The student will be able to develop an consistent philosophy of optimum environment related to living things.
2. The student will be able to develop the ability to work with the scientific method to accomplish effective experiments.
3. The student will be able to accept responsibility of validity of experimental results.
4. The student will have an increased sensitivity to the needs of living things.
5. The student will be able to draw his own conclusions about optimum environment from direct experimental data.
6. The student will be able to propose a hypothesis for further investigation.
7. The student will be able to receive the satisfaction of discovering facts.
8. The student will be able to account for variations in experimental data.

Directions to the teacher:

Hypothesis: Does the amount of media affect the population density of yeast in vitro?

This hypothesis will try to determine the validity of Part II. The importance of following strict procedure when using the scientific method should be stressed. Strict procedure is an important as the responsibility of reliable manipulation and is as important as formulating reliable predictions from the collected data.

Directions to the students:

Proceed as in Part I & II. Graph population densitites of all tubes with the media concentration. Propose a hypothesis for further investigation of optimum environment. How can one account for the variations in collected data? According to the data collected, what is the affect of the amount of media on the population density? How does the information affect the information gathered in Part II?

TUBE	A	B	C	D	E	F	G	H	I	J	K
MEDIA IN ML	10	9	8	7	6	5	4	3	2	1	0

Materials:

Test tubes; test tube rack; dried brewers yeast; dark corn syrup; graduated cylinder; masking tape; eye droppers; slides and covers; and microscopes.

Senior High Submitted by Sally Lowe

ENVIRONMENTAL BOOK FAIR

Behavioral Objectives:

1. The student will be able to name sound environmental principles and to select books that embody these principles.
2. The student will be able to give examples of books and magazines which relate to different aspects of the environmental crisis.
3. The student will be able to demonstrate how some books will promote good environmental practice.
4. The student will be able to identify sources of environmental literature in the community and to select the sources that he will use in the future.
5. The student will be able to organize the books for sale around environmental themes.
6. The student will be able to appraise the contents of two books of similar title, and to advise prospective buyers of the values of each book.
7. The student will be able to demonstrate commitment to informing others of environmental problems and "selling" others on possible solutions by giving tours of the fair.
8. The student will be able to design an advertisement for the book fair, using his knowledge of the environmental crisis to interest others.

Directions to the teacher:

A tentative date should be set for the book fair and a room, hall, or auditorium reserved.

Students should visit stores and libraries in the community to compose lists of titles to order.

Another committee of students may write to environmental magazines, explaining the coming book fair and requesting a sample copy of the magazine and some subscription forms.

A committee should contact a local book distributor or bookstore and inquire about arrangements for the fair. A book distributor will probably have more books on hand and have access to other titles. The class will need to study the terms: usually arrangements can be made to borrow one copy of each title for the several days of the book fair, with the total order for books which comes from the fair being filled afterward.

The class should devise a procedure for taking book orders from customers at the fair and for collecting money in advance. You should also consider how books will be distributed when the final order arrives.

Directions to the students:

Now, plan your book fair promotion. Be sure to utilize all available media at the school to interest students and teachers in the coming book fair. A special school assembly might be arranged to inform the student body of environmental problems.

Plan the arrangement of your book fair. Your distributor or bookstore may be able to provide book racks. You should arrange to have a number of tables to display books attractively. Environmental posters provide a nice background. One table should be set aside for display of magazines and subscription forms. A suggested arrangement for books is as follows:

I. Nature Section
Books on natural wonders, field guides for animals and plants, Sierra Club books

II. Environmental Crisis Section
Books exploring the problems of pollution, overpopulation, the fuel shortage, extinction of animals, depletion of resources, problems of cities, prospects for the future.

III. Environmental Action Section
Books such as The Organizer's Manual which explore public action, books on recycling, preservation of natural resources

IV. Lifestyle Section
Books which explore alternative lifestyles: books on natural foods, bicycling, building domes and junk houses; do-it-yourself books, craft books, and catalogs such as The Whole Earth Catalog which provide access to resources.

In addition, you may wish to ask your public health clinic and local crafts and natural food stores to set up demonstration tables and to provide free information to fair-goers. Free booklets they might provide on birth control or vegetarian recipes might be an additional incentive for people to attend the fair. Other community resources might include: the local animal shelter, the power company, Goodwill.

Schedule students to man the book fair tables during the day. The class should discuss the behavior of salespeople, their duties, and possible problems to be dealt with, such as book theft. Students should familiarize themselves early in the fair with the books at their tables. Guides should be

appointed to keep the fair running smoothly. An order table and order procedures should be set up. Invitations should be issued to all teachers, inviting them to bring their classes to the fair.

Following the fair, don't forget thank you notes to community people who provided tables. A general report on the fair and a "thanks for your support" can be circulated in the school's daily announcements. Deliver orders promptly when books arrive, or have a central pick-up point.

Finally comes the most rewarding decision: how to spend the earnings from the fair. Most distributors will allow you to retain 30-40% of the money you collect for book orders. You may feel that many of the books you saw are necessities for your school library. In that case, it is your turn to select books from the book fair.

Materials:

Poster paper, poster paints, environment posters, order forms, a place to use for three to five days, tables, book racks, books on loan from a bookstore or distributor, and cashbox.

Senior High Submitted by Sally Lowe

LIFE STORY OF EVERYDAY ITEMS

Behavioral Objectives:

1. The student will be able to identify some resources which are used to produce everyday items.
2. The student will be able to distinguish between these items which are necessitites and those which are not.
3. The student will be able to discover ways to reuse certain items.
4. The student will be able to separate items made from non-renewable resources and those from renewable resources.
5. The student will be able to explain the problem of over-packaging, and why manufacturers over-package.
6. The student will be able to write alternative life stories about an everyday item, and will appraise the life stories in terms of environmental impact.
7. The student will appreciate the power of his everyday choices in buying and discarding and the impact of his choices on the environment.
8. The student will be able to design a plan to change his behavior toward some everyday items.

Directions to the teacher:

This activity can be carried out in two days. You will need to prepare a bag of everyday items for each day.

On the first day, lead your class in brainstorming about the bag you have brought and its contents. Remove one item at a time and ask students to describe the history of each item. What is it made of? Where did it come from? What processes were used to make it? Be interested in containers as well as in the product; consider the tooth- and the tube.

Next, consider the item's original purpose. Is it necessary? Could a cheaper or more environmentally sound substitute be found? Is there excess packaging? What is the purpose of the packaging?

The item's future is the next topic. What will happen to it? Will the toothpaste box be discarded as litter, garbage or smoke? The tube?

Finally, discuss alternatives. What alternatives are there to purchasing the item? Are there better production practices which could be used? How new is this item in our world-has man always used it? What did he use before he found this? What do we gain and what do we lose from buying and using and discarding this item?

Proceed through your bag, brainstorming each item. Students may want to discuss the bag itself. During the discussion, some terms should come up and they can be defined by the class: non-renewable resource, recycle, reusable, necessity, over-packaging.

By the time the discussion has ended, students may be impressed by their power: they vote every day on the world's condition by the way they buy, use and discard. They may see that this is an area where wise choices are necessary.

On the second day, the items from the bag should be unveiled without comment and placed around the room where they can be seen. Give the students an example of the pattern they can follow in writing three life stories for the item they choose. (A student example follows) The origin remains the same in each story, but the manufacturing process, the product, or re-use of the product can be changed.

Two follow-up activities are suggested:

Present some of the life stories to the class to allow practice in choosing the best alternative for an item. The stories can be read, or they can be presented by groups as skits in which students role-play the product. The most healthy life story can be selected after the class discussion.

Assign an action: a letter to a manufacturer, a complaint to a store manager, a change in the student's buying or disposal habits. Students can write up their proposed action and report on the results at a later time.

Directions to the students:

Read the model you have for three life stories of a candy box. Using the same form, write three life stories for any item from today's bag. Be imaginative, but be sure your stories are possible.

Materials:

Suggested items for Bag Number One: plastic bag; light bulb; overpackaged instant soup; coat hanger; used manila envelope; apple juice bottle; and junk mail.

Suggested items for Bag Number Two: paper bag; block of wood; cigarette carton; aerosol spray can; used Christmas card; piece of string and old sock.

Comments:

Student example of life stories of empty candy box

Box Number One: Born in a forest. Manufactured into a cardboard and then into box. Filled with candy. Candy eaten and box thrown away. Burned in incinerator and became smoke and ashes.

Box Number Two: Born in a forest. Manufactured into cardboard and then into box. Filled with candy. Candy eaten and box used to hold pieces of a chess game.

Box Number Three: Born in a forest. Manufactured into cardboard and then into box. Filled with candy. Candy eaten. Grandma made box into a little game for the kids. She cut doors and windows and added people. Children played with the toy box until it was demolished. Box then put into the trash. Picked up by garbage collectors and sent to dump.

By Michele Manlove

Senior High

Submitted by Sally Lowe

STUDENT TRANSPORTATION SYSTEM

Behavioral Objectives:

1. The student will be able to describe the effects of the fuel shortage in the United States experienced in 1973 and 1974.
2. The student will be able to explain the benefits of a high school Student Tranpsortation System(STS).
3. The student will be able to compute the fuel savings of doubling up in cars and to demonstrate the savings to others.
4. The student will subdivide a city may and identify the most direct car routes to school.
5. The student will be able to compile data from interested driver teams and organize a master plan.
6. The student will be able to explain and justify rules for the STS to others.
7. The student will be able to assist others in working out problems associated with the STS.
8. The student will be able to construct bulletins and posters to interest the student body in the STS and will organize a general information bulletin with finalized STS plans.

Directions to the teacher:

News articles about the fuel shortage are readily available now and can familiarize students with the problems. Point out to the class that experts have urged the formation of car-pools by students and workers. Discuss and compute the fuel savings of a hypothetical transportation pool. Ask the class to name any alternatives available now to students who wish to give up their cars to save fuel.

As coordinator of this project, you will need to clear the idea with the school administration before proceeding. A disclaimer of responsibility for results of the STS may be required by the school administration from prospective drivers and riders.

Preliminary research by the class is necessary to the project. The class can survey the student body to determine how students are getting to school now and whether they would use a transportation service. A committee should be assigned to identify areas served by school bus or municipal bus. Student body officers and school administrators could be invited to class to brainstorm ideas for and problems of a STS and to suggest ways information can be relayed to students and teachers about the new system.

The need for serious commitment on the part of assigned drivers should be emphasized to the class.

As a follow-up to the establishment of the STS, the class could call drivers for reports after the system has been in progress for several weeks. Interpersonal and practical problems may have to be discussed and worked out at this point.

Directions to the students:

Your preliminary research will show the needs of your student body and areas in the city where transportation is needed. Divide your city into areas which are not serviced by bus. Your areas should be small enough to be served by one driver. Name or number the areas.

Recruitment of drivers is the next step. Using the school bulletin, newspaper, assembly or work of mouth, announce the need for STS drivers from each area. Drivers must volunteer in teams of two from each area: one main driver and one back-up driver. As drivers appear at the classroom door to volunteer, make sure they are committed for the full term, note their names and phone numbers on the master city map, and inform them that they will be called soon for a special required driver's workshop.

Organize the workshop for potential drivers. At this point the class should make up a tentative contract between driver and rider, including performance pledges for each. The contract should include the driver's pledge to drive safely, to arrange substitute transporation in the event of illness, and to be on time. He should also pledge that he is a licensed and insured driver. The rider's pledge would include a promise to be prompt, to inform the driver if a ride is not needed, and to pay his fair share of gasoline.

The class may want to make an ecology flag for each driver's antenna or to decide on another distinguishing symbol for STS cars. This would help to inform the student body of the system and to identify the driver as someone who is trying to help preserve the environment and save fuel.

At the workshop, drivers should hear a traffic safety officer or a driver's education teacher safe driving pointers. The master plan can then be explained to drivers by a prepared member of the class. The contract should then be dicussed. Drivers may think of additional items to be added. Other prepared students should be called on to role-play a meeting between the driver and potential rider, in which the driver explains the system and the contract and both sign the contract. At the end of the workshop, all agreeable drivers should make a final commitment to the program and be given identifying symbol and area map, as well as the name and phone numbers of back-up drivers for the area.

Next comes the recruitment of riders. An all-out advertising campaign is needed here, to convince students to give up their cars and ride in car pools. An information sheet should be prepared for interested riders, including the area map of the city and the name and phone number of the main driver for each area and the basic contract. Your class has provided the basic information and it is up to the rider to make contact with the driver for his area.

You will probably be curious to see the results of the STS, and your teacher will suggest a follow-up survey you can use.

Materials:

Mimeograph or ditto facilities, good city map

Comments:

A speaker from an organized car-pool in another city would be very helpful in outlining problems of the system used there, and helping the students set up rules. Fort Collins has a student transportation service.

Senior High Submitted by Willaim Parsons

A COMPARISON OF THE TAR CONTENT OF VARIOUS BRANDS OF CIGARETTES

Behavioral Objectives:

1. The student will be able to set up and perform the experiment according to instructions.
2. The student will be able to determine the quantity of tar in each brand of cigarette tested.
3. The student will be able to identify at least three harmful substances found in cigarette smoke.
4. The student will become aware of the effect of cigarette smoke on the human body by submitting a written report of two or three hundred words.
5. The student will become aware of the relationship between the odor of the cigarette tar obtained in the lab and the cigarette tar trapped in the human respiratory system.
6. The student will be able to relate the calculated risk a smoker takes in developing lung cancer and the odds involved in successful corrective surgery.
7. The student will become aware of the cost involved, both monetary and physical, in smoking for a given period of time.
8. The student will be able to develop laboratory skills by manipulating and making changes in the laboratory set-up so that experiments may proceed more efficently.

Directions to the teacher:

A variety of cigarettes may be provided for the experiment, but an interesting comparison can be made by using cigarettes with and without filters of the same brand.

Cigarette holders can be made by joining several small pieces of plastic tubing increasing size until the correct size is obtained to fit a cigarette. Filter paper can be obtained from Eduquip Inc., 1220 Adams Street, Boston, MA.

Directions to the students:

Work in teams of two or three. There are two procedures to follow, one for Team A and one for team B.

Procedure A:

Place a special filter paper in the holder, attach the squeeze bulb to the filter holder and the cigarette holder to the opposite end of the bulb. Insert a cigarette in the

holder, light the cigarette and squeeze the bulb slowly to force all air from the bulb. Squeeze the bulb about one time every three seconds. Continue squeezing the bulb until the cigarette contains about one inch of tobacco. Remove the cigarette and extinguish it.

Remove the filter from the holder and note how dark the tars in the smoke have made the filter. Write the brand anme of the cigarette used on the filter paper. Place a new filter in the holder and a different brand of cigarette into the cigarette holder. Repeat the same procedure as before. Try two cigarettes of the same brand, one with and one without a filter. How do the papers compare in tar content?

When you have prepared one filter for each brand of cigarette, compare the color of the filter paper with the color comparison sheet. Note that the stain comparison sheet has listed the number of milligrams of tar required to produce each stain. After making comparisons of the tar stains, write the number of milligrams of tar on each of the filter papers with the brand name of the cigarette.

Smell the tar on the filter paper. You are looking at and smelling the same material that smokers inhale into their lungs, although the quantity per cigarette can be different.

Porcedure B:

Fit a gallon jar with a two hole rubber stopper. Into one of the holes, insert a three inch length of glass tubing so that the end of the glass is just protruding from the smaller end of the stopper. Into the other hole, insert a length of tubing so that one end extends to the bottom of the jug and the other end protrudes about an inch through the large end of the stopper. Attach about a foot of rubber or plastic tubing to the longer piece of glass tubing and insert a cigarette holder in the flexible tubing. Place a two foot length of flexible tubing on the short glass tube in the stopper.

Fill a gallon jug with water, place the stopper in the jug, and without allowing the water to run out, turn the jug upside down. The jug must be held in this position for the entire experiment, so find a comfortable way of supporting it.

Fit four or five 4 ounce gas bottles with two hole stoppers. Into each stopper, insert a length of glass tubing almost to the bottom of the bottle and protruding about an inch from the larger end of the stopper. Into the other hole, insert a three inch length of glass tubing that just protrudes from the smaller end of the stopper. Repeat this procedure for each bottle. Connect the short piece of glass tubing of one bottle to the long length of glass tubing to the next bottle with a six inch length of flexible plastic tubing. Do this with all four

bottles in the same manner except the plastic tubing entering and leaving the two end bottles will have plastic tubes of about a foot in length.

Now place the long plastic tube attached to the short piece of glass tubing on one end bottle to the long length of glass tubing of the jug. Place a cigarette holder in the long piece of plastic tubing attached to the long glass tube in the other end bottle.

Fill each bottle about two-thirds full with various liquids as: water, alcohol, odorless paint thinner, or mineral oil. Your teacher may have you substitute other liquids. Insert a cigarette into the holder. When you are sure that the tubing carrying water from the jug is in a drain, light a cigarette while allowing water to flow from the jug. You will notice smoke bubbling through the gas bottles and into the jug as the water leaves the jug. When the cigarette has about one-half inch of tobacco remaining, stop the flow of water and remove the burned cigarette.

You may repeat the experiment and switch the order of the liquids in the gas bottles. Note whether or not the order of solvents made any difference in the quantity of tar picked up by the solvent. The liquids may be transferred to evaporating dishes and placed in a warm place overnight or until the solvents evaporate. Compare the odors of the tar obtained in this manner with the tars obtained by procedure A.

Can you think of suggestions for a more efficient operation producing better results of this experiment? Compute the cost per year of pack-a-day smoker.

Check the behavioral objectives for completion. You may need to use the library for additional information.

References:

Eduquip Inc., 1220 Adams Street, Boston, MA 02124

Senior High Submitted by William Parsons

THE EFFECT OF CIGARETTES ON THE HUMAN BODY

Behavioral Objectives:

1. The student will be able to recognize at least three effects that smoking has on the human body.
2. The student will be able to translate simple data into an informative graph.
3. The student will be able to relate the harmful effects of smoking on the body by writing a summary of two to three hundred words.
4. The student will be able to calculate the extra volume of blood pumped by the heart due to the smoking of one pack of cigarettes.
5. The student will be able to predict the effect smoking has on the taste buds.
6. The student will be able to explain the temperature drop in the smoker's toes and fingers after smoking one cigarette.
7. The student will be able to appreciate the physically and mentally superior position a non-smoker has compared to a smoker.
8. The student will be able to develop an awareness of significant air polluted areas in every day environment and avoid them.

Directions to the teacher:

You will need to find several persons who smoke and might enjoy helping the students perform experiments. There are probably several smokers who are unhappy about their smoking problem. Some of these people would not be offended if asked to help the students perform experiments.

Directions to the students:

Find a smoker who will be willing to allow you to perform a test with him. Ask the smoker to inhale from a lighted cigarette and to make every attempt to hold the smoke in his mouth without allowing it into his lungs. As rapidly as possible, after inhaling from the cigarette, place a handkerchief over the smoker's mouth and stretch it as tightly as possible while he blows the smoke through the handkerchief. Note the dark stain on the handkerchief.

Now have the smoker inhale from the cigarette and allow the smoke to go into his lungs. Have the smoker exhale, as before, through a different tightly stretched white handkerchief. Compare the stain on the second handkerchief with the stain on the first. How do you account for the difference?

Have the smoker blow smoke through a handkerchief two or three times without having it go through his lungs. Compare it with another handkerchief in which the smoke has gone through the smokers lungs two or three times. Note the difference in the stain.

Find a smoker who has not had a cigarette for quite some time. Take the smoker's pulse several times to be sure that your count is consistent. Now have the smoker smoke the cigarette, taking the smoke into his lungs as usual for three or four puffs. Take the pulse again and take the pulse again every fifteen minutes until the pulse rate returns to normal.

Chart your findings on a graph and determine how many extra beats one pack of cigarettes causes the smoker. One heart beat pumps approximately 70 cc of blood. Calculate the extra volume of blood that is pumped by the heart due to smoking one pack of cigarettes.

Find a smoker who has not smoked a cigarette for several hours and let him hold a thermometer between his fingers or toes or both. After obtaining a good accurate reading, have the smoker smoke a cigarette. Again obtain a good accurate reading of the thermometer and compare it with the first reading. How do you explain the difference in the readings?

Now check the behavioral objectives and complete each one.

References:

_____, Smoking and Heath Experiments, Demonstrations, and Exhibits, U.S. Department of Health, Education, and Welfare, Superintendent of Documents, U.S. Government Printing Office, Washington, D. C.

Senior High Submitted by William Parsons

EFFECTIVENESS OF THE COTTRELL PRECIPITATION ON CONTROLLING SMOKE POLLUTION

Behavioral Objectives:

1. The student will be able to construct a simple working model of the Cottrell Precipitator by reading the diagrams and following the directions.
2. The student will be able to draw a simple diagram of the electrical circuit of the Cottrell Precipitator and label the various parts of the diagram as being postively or negatively charged.
3. The student will be able to recognize the importance of control by keeping all of the conditions as nearly the same as possible except the test situation.
4. The student will learn the importance of improvising by contriving at least one method by which the model could be made to function better through some change in the directions of construction, the materials used, or in any other way.
5. The student will be able to acquire a degree of self-reliance by being able to share with others knowledge gained by reading at least three sources of air pollution information.
6. The student will be able to develop a skill of finding information on a given subject by using the card file index in the library and finding at least three articles on pollution written in the last five years.
7. The student will become aware of the air pollution problem that exists by listing at least three sources of air pollution and identifying at least one harmful agent in each source.
8. The student will be come acquainted with the various pollution problems and possible solutions by relating ways at least two serious pollution problems have been solved in recent times.

Directions to the teacher:

The cardboard tube on which rugs or carpet is rolled can be cut into one or two foot lenghts. This tubing is usually very heavy and sturdy enough to remain rigid after all the slits have been cut or sawed into the tube to accept the plates. The plates may be cut from any thickness of conducting materials as aluminum or steel.

The ends of the tin cans can be used satisfactorily. The alternate plates can be connected by soldering wires if the plates are not made of aluminum, however, short wires with alligator clips would be desirable to connect aluminum plates to each other.

Incense can be used as a source of smoke without making the odor in the room too objectionable. Cigarettes or other materials which will produce smoke can be used.

Be sure to caution the students about the danger of high voltage and explain the care which must be taken. The student should show his model to you for checking and approval before putting it into operation. One model should be used as a control by setting up two models the same in every detail except that one is plugged into a D. C. source of electricity. The students should alternate models by charging only one of the models.

Directions to the students:

Work in teams of two. Obtain a length of cardboard tubing about one to two feet long. Cut slits about two-thirds of the way through the tube perpendicular to the length of the tube, alternately on opposite sides of the tube and about one-half inch apart. Be careful to cut the slits straight and perpendicular as the plates of metal which you will cut later must slide snugly into the slits. A hack saw, saber saw, or any saw with a very thin, fine-toothed blade may be used. The slits cannot be too wide as the metal plates which will be inserted into the slits must be nearly air tight. No slits should be cut into the last three inches of the tube as this will be the base of the tube in which the smoke generator will be placed.

One or two small holes, about 1/8 inch in diameter should be drilled about 1/2 inch from the bottom and on opposite sides of the tube in order for the smoke generator to receive air.

The plates may be cut from aluminum or the ends of tin cans may be used for the plates. The plates should be cut large enough to protrude about 3/8 of an inch on opposite sides of the tube so that connections can be made with wire. The plates need not protude from the tube except on the opposite sides where the connections are to be made. The plates must not be cut smaller than the outside circumference of the tube because the plate is held in place by the walls of the tube. The plates must be held rigidly and cannot be set closer to each other than the 1/2 inch, or they will probably short out.

After inserting a plate into each slit in the cardboard tube, connect all the plates on one side of the tube together. If the plates are aluminum, use alligator clips and if the plates are steel, use soldering for connecting plates. Connect all of the wires together on the opposite sides of the tube in the same manner. Each series of plates on opposite sides of the tube must be connected with wires to the voltage source. This arrangement will cause one set of plates to become charged negatively and alternate set to become charged postively.

Inform your teacher when your wiring is completed and when you are ready to have your model checked for satisfactory construction and safe operation. The teacher will caution you about working with high voltage electricity because of very severe and painful shock.

When your teacher has given you permission to operate your model, ask another student who has completed his model to use it as a check on yours. Both of you will proceed exactly in the same manner and try to keep every detail of your experiment the same. Both should use the same source of smoke in exactly the same manner so that both models will take in the same amount and kind of smoke. The only difference between the two models will be that while one is turned on and operating while the other is not. See if there is a difference in the amount of smoke coming from the top of your models. Do you think that the model in operation is handling the smoke differently than the other one? When you have observed the two models long enough for a good comparison, turn your model off and turn the other model on. Again compare the results of the two models. If you experience any difficulties or have any questions, be sure to check with your teacher.

If your model has operated satisfactorily, study the behavioral objectives and be sure you can complete all the requirements satisfactorily.

Senior High Submitted by William Parsons

EXTRACTION OF SILVER FROM PHOTOGRAPHIC HYPO

Behavioral Objectives:

1. The student will be able to compute the percentage composition of silver in one liter of used photograph hypo.
2. The student will be able to give at least three examples of how heavy metals pollute our streams and rivers.
3. The student will be able to identify the precipitate, the gas given off while heating the precipitate, and the remaining filtrate.
4. The student will be able to prepare a normal, molar and molal solution of hydrochloric acid.
5. The student will become aware of the water pollution problem that exists by listing at least three sources of water pollution and be able to state a method of controlling the three sources of pollution.
6. The student will be able to predict at least one other possible method of removing silver from a solution.
7. The student will be able to discover one method for testing sulfur dioxide gas.
8. The student will become acquainted with the procedure involved to test for a sulfate compound.

Directions to the teacher:

The photographic hypo can be obtained by requesting the person in charge of the school's darkroom to save worn out hypo.

It would be interesting to have the student try to obtain the black silver sulfide precipitate from new hypo as well as used.

A hot flame, hotter than the bunsen burner, can be obtained by a small propane torch. A still hotter flame can be produced from a small portable solid oxygen welding kit. The oxygen in the welding kit is supplied by using oxygen producing tablets when placed in a container of water.

The table tops may be protected by using several thicknesses of asbestos and by holding the charcoal blocks in a burette clamp placed on a ringstand.

Directions to the students:

Pour one liter of used photograph hypo into one liter boiling flask. Weigh 20 grams of ferrous sulfide and place in a 500 ml erlenmeyer flask fitted with a one hole stopper. Insert a 3 inch length of 5 mm glass tubing into the one hole stopper so that the glass is just protruding from the smaller end of the stopper.

Place a length of glass tubing into the hypo so that the end is about two inches taller than the flask. Connect the two glass tubes with a length of rubber or plastic tubing.

After placing both flasks in the hood and turning the fan on, pour enough 6N hydrochloric acid into the 500 ml flask to easily cover the ferrous sulfide. Place the stopper into the flask snugly. The gas generated is hydrogen sulfide which is foul and very poisonous. Be careful not to allow any of the gas to escape into the room.

You will notice the hypo turning gray and black as the gas continues to bubble through the hypo. After the gas has bubbled through the hypo at a rather vigorous rate, flood the gas generator with water while still in the hood. Filter the black precipitate from the solution with filter paper.

Dispose of the water in the gas generator. Be careful to save any remaining ferrous sulfide. Again add enough 6N hydrochloric acid to cover the ferrous sulfide. If no gas is produced, then add 5 or 10 grams of ferrous sulfide and again bubble the hydrogen sulfide gas through the filtrate. If no further gray or black precipitate forms, then flood the gas generator as before. If a precipitate forms in the filtrate, continue to bubble the gas through the filtrate for 10 or 15 minutes. Filter out the black precipitate as before and again test the filtrate with the gas for additional precipitate. Save any remaining ferrous sulfide and place it in the container furnished by your teacher. Allow the precipitate to stand overnight or until dry.

Place the black precipitate with the filter paper into a crucible. Heat the crucible gently until the contents are perfectly dry and the paper is burned. Increase the temperature of the precipitate by heating the contents of the crucible with a propane torch while the crucible is still being heated over the bunsen burner. If this does not produce molten metal in the bottom of the crucible, then take the contents of the crucible and place into a shallow depression made by scraping a block of charcoal with a knife. Continue to heat the material on the charcoal block until white hot. You will find a small nugget of silver colored metal.

Check the behavioral objectives to see if you can answer them completely.

Senior High Submitted by William Parsons

FEED FOR LIVE STOCK THROUGH HYDROPHONICS

Behavioral Objectives:

1. The student will be able to name three main elements which plants consume in relatively large amounts and six trace elements stating the purpose of each in plant growth.
2. The student will be able to determine the near optimum conditions for germination of wheat, barley, and oats.
3. The student will be able to prepare percentage solutions, normal solutions, and molar solutions.
4. The student will be able to explain the inverse square law by giving at least three examples of how illumination is related to light intensity and the distance from the source.
5. The student will be able to recognize at least three symptoms of mineral deficiencies in plants and be able to describe them.
6. The student will be able to effectively use the voltmeter and ammeter and be able to compute the cost of using a given light fixture for a given length of time.
7. The student will be able to compute the percentage weight increase of total edible foodstuff produced by ten days growth.
8. The student will be able to explain at least three advantages and three disadvantages of growing live stock feed indoors by hydrophonics.

Directions to the teacher:

Plastic trays measuring approximately 12"x24"x2" work well, however, any kind of shallow pan can be used. Enough seeds should be placed in the trays to cover the bottom of the tray. The seeds will not support the green stem after germinating unless some kind of material is added to the tray for root stabilization. The most difficult part of the entire operation is to keep the seeds wet enough to grow well, but yet not so wet as to rot or mold. Peat moss, vermiculite and cut straw all hold moisture well and will support the root system. These materials can be removed from the roots when growth is complete.

The University of Wyoming will analyze a sample of growth free for a school. They will report the protein content as well as the content of several vitamins.

Directions to the students:

Work in teams of two. Place the seeds of barley, wheat, or oats in shallow trays so that the bottom is completely covered, but yet the seeds are not piled on each other. Remove the seeds to weigh and record. Return the seeds to the tray and cover with a thin layer of peat moss, cut straw or vermiculite until the seeds can no longer be seen.

The end of the tray should have a hole into which a one hole rubber stopper with a piece of three inch glass tubing is inserted so that the glass is just even with the small end of the stopper. A length of two or three feet of rubber tubing is connected to the glass tubing to provide a drain for the tray.

Next, mix a gallon or 4,000 cc of nutrient solution according to the directions. The solution is sprinkled carefully over the seeds. Be careful not to distrub any of the seeds. The solution is added until the contents are wet. Any surplus solution will drain from the tray through the tubing. The tray can be inserted into a plastic bag which will help retard evaporation. The bag should be loose fitting so it doesn't shut off the air. The bag is used to prevent the seed bed from completely drying out.

The seeds will take a day or two to germinate and must be kept moist during this waiting period. After the second day, the tray should be placed under the fluorescent light so that the germinated seedlings will grow up through the peat moss. The tray should be about eight inches from the light.

As the young plants grow, the nutrient solution will have to be added two or three times every day, in the morning, at noon and late in the afternoon. The tray is flooded and the excess solution can slowly drain from the tray into a gallon jug. The solution should be aerated twice a day for a minute or two with an air bulb and air stone. The solution will probably need to be filtered every day and replaced when it takes on a disagreeable odor.

A luxurient growth should begin in less than a week and should reach a height of about six inches in ten days. In about ten days, remove the growth mat from the tray and wash off any peat moss, straw or vermiculite. Allow the mat to lose all excess water by evaporation and then weigh. Now you can easily compute the percentage increase weight of growth.

Your teacher will give instructions for preparing a sample to be sent to the University for nutrition analysis.

You may be able to mechanize your solution exchang system with a small pump, timer and aerator. It will be interesting to compare your crop with regular animal feed.

References:

_____, Growing Plants Without Soil For Experimental Use, Miscellaneous Publications No. 1252, Agricultural Research Service, U.S. Department of Agriculture, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

Senior High Submitted by William Parsons

PEST CONTROL BY MEANS OF ULTRASONIC VIBRATIONS

Behavioral Objectives:

1. The student will be able to determine the frequency of ultrasonic sound effective in repelling mosquitoes and fruit flies.
2. The student will be able to write about three practical uses of ultrasonic vibrations in addition to those of this experiment.
3. The student will be able to summarize the effects of various frequencies of sound and at different intensities on mosquitoes and fruit flies.
4. The student will be come knowledgeable with the inverse square law as applied to the relationship between intensity of sound and distance.
5. The student will become skilled in setting up and operating the audio generator, amplifier, and the oscilloscope
6. The student will be able to explain the terms: frequency, wave length, amplitude and quality of sound.
7. The student will be able to develop an awareness that there are methods of pest control which need to be investigated in addition to environmental polluting poisons.

Directions to the teacher:

It is quite possible that an audio generator, amplifier, and oscilloscope can be borrowed from the physics department. It is also possible to build a small audio generator for about five dollars for the electronic components.

It may be difficult to obtain mosquitoes during the winter, however, fruit flies or other insects may be substituted.

Directions to the students:

Work in teams of two or three. Set up the audio generator, amplifier, and oscillscope with a small speaker in an isolated area. Adjust the frequency of the audio generator to a very high pitch, perhaps 16,000 vps. Check the equipment to see if it is in working condition.

Release about hundred mosquitoes into the room. When the mosquitoes land or fly in your immediate area, turn your equipment on to a moderately loud tone. Be sure that the speaker is very close to you. If the mosquitoes are not repelled by the tone, increase the frequency until they are repelled. Keep increasing the frequency of the tone until they are repelled.

After you have found a frequency that repells the mosquitoes, move the speaker a few feet away from you to see if it is still effective. You will have to experiment with the distance of the speaker and the intensity of the tone to find a practical distance that will offer good protection from mosquitoes.

See if you can find any relationship between your distance from the speaker and the intensity of the tone needed to keep the mosquitoes away. If you double your distance from the speaker, how much does the intensity of sound need to be increased to produce the same degree of loudness?

Sometimes a pulsating tone is more effective in repelling pests than a steady one. Perhaps you can think of a way of producing a pulsating tone by controlling the volume.

As you have experimented with the various frequencies of sound, did you note any relationship between their patterns as seen on the oscilloscope?

You may wish to build a small inexpensive mosquito repeller. Your teacher can supply you with the information needed for this project.

Now that you have been able to control mosquitoes to some extent, how do you think the same arrangement would work on flies or other pests? Repeat the experiment using fruit flies instead of mosquitoes. How do the frequencies that are effective for mosquitoes compare with those which are effective on flies.

Check the behavioral objectives to see if you can answer all of them.

Senior High Submitted by Dean Runkle

ENERGY AND THERMAL POLLUTION

Behavioral Objectives:

1. The student will be able to list six or seven energy consuming devices used around his home.
2. The student will be able to construct a graph that shows the present energy consumption in the U.S. and project the consumption of energy to the year 2000.
3. The student will be able to determine the efficiency of energy plants from data supplied to him by the teacher.
4. The student will be able to write and balance a chemical equation for the neutralization of carbonic acid with sodium hydroxide.
5. The student will be able to determine the relative solubility of carbon dioxide gas in water at various temperatures.
6. The student will be able to predict how soluble gases other than carbon dioxide are in water at various temperatures.
7. The student will be able to devise other experiments to test the effects of thermal pollution in streams or lakes.
8. The student will be able to manipulate the necessary laboratory equipment well enough to get reliable test results.

Directions to the teacher:

Therral pollution and its effects, the underlying effect of dumping waste into streams, may not be fully understood by many students. The solubility of gases in water differs from that of solids in water. Energy sources and uses in the United States would be good starting points. Many tables are available from the U.S. Bureau of Mines that project energy sources and uses to the year 2000.

This unit should concentrate on energy plants that cause thermal pollution and consequently release heat into the environment. The efficiency of steam-electric and nuclear energy plants should also be discussed.

Develop the Kelvin scale for temperature. The titration in this experiment is relatively simple and can be successful without a chemistry background. Acids, bases, and neutralization discussions will be helpful if the students have not had chemistry. Point out that most gases behave like the carbon dioxide in water and this may lead to another experiment dealing with dissolved oxygen in stream or lake water.

It is important that the sudent understand that a low oxygen concentration is not necessarily caused by thermal pollution. Warm water will speed-up the rates of chemical reactions so perhaps the iodine-clock experiment might be included to further understand thermal pollution.

Directions to the students:

One effect of thermal pollution is that the solubility of gases dissolved in a stream changes with temperature. In this experiment you can observe the amount of gas dissolved in a solution at various temperatures. The gas used in this experiment is carbon dioxide. A solution of this gas is readily available as soda water. Since the solution is acidic, it can easily be titrated with a dilute solution of sodium hydroxide.

When you open a bottle of soda water, the solution is supersaturated and therefore should be stirred with a glass rod until the fizzing stops. Obtain a 50 ml. buret and clean it thoroughly. Rinse several times with 5 ml of the base. Fill the buret with sodium hydroxide solution. Add 25 ml. of cold soda water to a 250 ml. flask. As soon as the fizzing has stopped, add 2 or 3 drops of phenophthalein indicator. Titrate the sample quickly. The end point is a very pale pink. Record the amount of base used. Repeat the experiment using soda water that is at room temperature and with a third sample that is at 65 degrees Centrigrade.

Make a table to show the amount of sodium hydroxide used for each titration. Why does a hot bottle of pop bubble over when the top is removed? From your experiment, what conclusion can you make about the gases dissolved in a stream or lake?

Materials:

Several bottles of cold soft drinks, thermometers, one buret per student, phenolphthalein indicator, graduated cylinders, three 1 0.1 M NaOH, 250 ml flasks and beakers, glass stirring rods, and buret clamps.

References:

Andrews, William A., 1972. Environmental Pollution, Prentice Hall, Inc., Englewood Cliffs, NJ.

Any general high school chemistry textbook.

Senior High Submitted by Dean Runkle

PHOSPHATE POLLUTION

Behavioral Objectives:

1. The students will be able to identify at least two sources of phosphates that enter our environment.
2. The student will be able to list at least four tests that can be used to determine the quality of water in the environment.
3. The student will be able to calculate the amount of a chemical necessary to mix standard and molar solutions.
4. The student will be able to show on a chart the amount of phosphates that occur in a stream at various locations.
5. The student will be able to conclude why phosphates are the most reasonable pollutants to eliminate from our environmental waters.
6. The student will be able to predict the solubility of various phosphates.
7. The student will be able to decide why phsophates are used in the detergents we are able to purchase.
8. The student will be able to manipulate a triple beam balance and use other laboratory equipment necessary to get good accuracy and reasonable test results.

Directions to the teacher:

Water in our area tends to be hard because it contains an excessive amount of minerals such as calcium and magnesium. These minerals are usually found as carbonates or bicarbonates and form insoluable precipitates with soaps and detergents. A thorough discussion in this area along with reasons for including phosphates in detergents will be quite helpful to the student.

A review of solutions and standard solutions will also be very helpful to the student. Standards should be mixed by the teacher and are better if not mixed more than several days before the experiment. You may be interested in a discussion of sodium nitriloacetate (NTA) as a substitute for phosphates. Other experiments such as, How Hard is the Water, or What is the pH of the Water may precede this experiment. These areas should be included as background material. You should encourage the students to do a number of independent investigations concerning the quality of water as is possible and time permits.

Directions to the students:

This experiment will help you determine how much phosphate is present in the natural waters in your area and in the detergents that may be used in your household. First, you should collect some water samples from lakes, streams or ponds in the area. Polyethylene bottles are probably better than glass and should be very clean before collecting any samples.

Two or three rinses with distilled water should be made before using them for your samples. You may also wish to bring some detergent samples from home to test for phosphates. In this experiment, we will use a series of colored tubes as standards. Your samples will be compared with the standards to determine the amount of phosphate present in the sample. The phosphate ion combines with ascorbic acid, ammonium molybdate, and sulfuric acid to give a colored compound. Your teacher will provide more detailed equations if you wish.

Prepare standard solutions by: Measure 40, 30, 20, 10 ml of standard phosphate into four test tubes and add distilled water to each so that final volume is 40 ml. Add 4.0 ml of ammonium molybdate-sulfuric acid solution. Add a few grains of ascorbic acid to the flask. Heat the solution to boiling, cool and then transfer the solution to a test tube. Place the tubes in a test tube rack for future use as standards.

When you wish to determine the amount of phosphate in a sample of water you collected, use the following procedure: In a clean erlenmyer flask, place 40 ml of the sample. Add the same chemicals to this water that you did to the previous standard samples. Match the color of your samples to the standards. Your sample will contain the same concentration of phosphate as the standard.

To determine the amount of phosphate in your detergent samples, it is necessary to treat the sample differently. Weigh a 1.0 gram sample of detergent into a one liter beaker and add 500 ml of distilled water. Stir. Take 10 ml of first standard prepared solution as described above and in another liter beaker add to it 500 ml of distilled water. Remove 40 ml of this second solution to a flask and treat it like you did the previous samples. Match the color with the standards to determine the concentration of phosphate.

Materials:

Necessary materials include 250 ml erlenmeyer flask, 250 ml griffin beakers, 50 ml burets, standard phosphate solutions, ascorbic acid powder, ammonium molybdate-sulfuric acid solution, test tubes, and test tube rack.

References:

Oxenhorn, Joseph M., 1970. Chemistry of Metals, Globe Book Co., Inc., New York, NY

Oxenhorn, Joseph M., 1969. Chemistry of Mixtures, Globe Book Co., Inc., New York, NY

Andrews, William A., and others, 1972. Environmental Pollution, Prentice-Hall, Inc., Englewood Cliffs, NJ

Senior High

Submitted by Dean Runkle

TESTING FOR LEAD

Behavioral Objectives:

1. The student will be able to list at least four sources of lead that enters our environment.
2. The student will be able to define the term: "octane rating".
3. The student will be able to calculate the mass of lead in a sample using a titration formula.
4. The student will be able to prepare the solutions necessary for testing samples for lead and explain the concept of molar solutions.
5. The student will be able to defend the method of collecting samples that he used in testing for lead.
6. The student will be able to write balanced equations for the chemical reactions used in calculating the mass of lead that was in the collected samples.
7. The student will be able to prepare a report on lead poisoning and report on its effects on the body.
8. The student will be able to manipulate the laboratory equipment necessary to get reasonable results when testing samples for the mass of lead they contain.

Directions to the teacher:

Discuss the sources of lead entering the environment. Investigate octane ratings and the addition of tetraethyl lead (TEL) to gasoline. Discuss how lead may be eliminated from gasoline and still give good results for use as fuel. Discuss how lead is emitted from the exhausts of cars and the various compounds that are formed and thus can be tested for by various chemical tests. It is important that you understand how this lead is concentrated near heavy traffic areas and how the wind and rain play a factor in the final disposition of the lead compounds.

You may also discuss how these compounds find their way into the food chain and lead to man. If plants are not available for testing, snow may be substituted. Even rainwater will give good results in some cities. A trial run may be made by wetting filter paper with weak HCl and placing it in the exhaust gas of a running automobile that is burning leaded gasoline. CAUTION: Be sure that the area is well ventilated and that the exhaust does not blow onto your face as it is not only hot but also contains carbon monoxide. Test the filter paper the same as other tests in the directions to the students.

The solutions are easily mixed by the teacher but are probably more meaningful if mixed by the students. Samples taken along a well traveled road should be taken from the roadway as well as regular intervals perpendicular from the road. Both sides may be tested but downwind from the road will probably give better results. The amount of lead should decrease as the sample site is removed from the road.

Directions to the students:

Leaded gasoline that has been burned in gasoline engines gives off insoluble [illegible]mpounds such as lead chloride, lead bromide, or other complex [illegible]d salts. Therefore to measure the lead it must be converted to [illegible]uble lead nitrate. Your teacher will give you help in obta[illegible]ning a sample of lead to be tested and also give you some assistance in determining a procedure in testing and sampling techniques. The basic idea is not only to test for lead but to get some idea about the distribution of lead along and from a well traveled road or highway.

Your results will be good only if carefully handled. After obtaining a sample put it in a beaker and add 20 cc. of 0.1 [illegible]ic acid. Stir vigorously for several minutes. Decant the acid into a 250 ml. flask leaving the residue behind. Wash the residue with a second portion of 0.1 M nitric acid, decant as before and add it to the first solution in the 250 ml flask. Add four or five drops of methyl orange indicator and then slowly add dilute sodium hydroxide until the solution turns a light yellow. Next add 0.1 grams of tartaric acid and mix well. Add ammoniacal buffer until a pH of 10 is observed. You may use pH test paper or a pH meter. Then add Eriochrome Black T indicator until a deep amber shade is noted. (probably about 2 ml.) Finally, titrate the sample with 0.01 M ethylenediaminetetraacetic acid until the amber color disappears. An olive green color is the end point. The equation is:

$$Pb^{+2} + H_2EDTA \rightarrow Pb(EDTA) + 2H^+$$

To determine the mass of lead in the sample you should use the following formula:

mass of Pb = no. moles EDTA x atomic mass of lead

No. moles of EDTA = volume EDTA in ml. x 0.001 x molarity EDTA

Using the information above can you determine the amount of lead that was in your sample?

Materials:

You will need the following materials: 250 ml beaker, two 250 ml flasks, pH test paper or a pH meter, filter paper, a 50 ml buret, 0.1 g tartaric acid per student, methyl orange indicator, solution of 0.1 M nitric acid, dilute NaOH, Eriochrome Black T indicator, solution of 0.1 M ethylenediaminetetraacetic acid, and two stirring rods.

References:

Curtman, Louis J., 1972. Introduction to Qualitative Chemical Analysis, The Macmillian Company, New York, NY.

Andrews, William A., 1972. Environmental Pollution, Prentice Hall, Inc., Englewood Cliffs, NJ.

Other high school chemistry textbooks and quantitative analysis texts.

Senior High Submitted by Jack Zolnoski

OCCUPATIONAL OPPORTUNITIES ON ENVIRONMENTAL PRACTICES

Behavioral Objectives:

1. The student will be able to compile a list of environmentally centered occupations.
2. The student will be able to determine his interests through interest testing.
3. The student will be able to determine his aptitudes through aptitude testing.
4. The student will be able to relate his aptitudes with his interests.
5. The student will be able to compile a specific list of environmental areas in which he has both the interest and aptitude.
6. The student will be able to compile a list of those schools which offer environmental opportunities in which he may gain further training.
7. The student will be able, upon contacting the above schools, to select high school subjects that will give him the necessary preparation before entering the college of his choice.
8. The student will be able, upon completion of his program to realize and experience the satisfaction of having selected and completed a goal which will prove beneficial to mankind.

Directions to the teacher:

The teacher should provide a source for occupational information from which the student may select those areas which relate to his future occupation. The Dictionary of Occupational Titles, Volumes I and II lists all occupations filed with the U.S. Department of Labor and gives descriptions of the functions performed in the occupations.

As the student progresses, other sources will become necessary. It is suggested that the teacher should have other materials available. Environmental and Outdoor Education Materials Company of Dowling, Michigan publishes a list of materials which should be in every counceling office.

The teacher should provide interest and aptitude tests for each student desiring and needing these tests. It is suggested that the Differential Aptitude Test be used because it will provide the student with both academic and non-academic scores.

The teacher should provide college catalogs and reference materials from which the student may obtain information concerning colleges.

In all cases the student should be encouraged to contact the schools by his own initiative to establish the seriousness of his intentions. The teacher should provide all the help possible when intentions have been established.

Directions to the students:

Contact your teacher, express your interest, and ask to see any information available which may have relation to your interest.

Ask to take an interest inventory and aptitude test. Seek the help of the teacher in interpreting your test scores. Make a comparison of the scores and conceive a plan of achievement. Compile a list of occupations that you believe correlate with your interests and aptitudes.

Examine the college catalogs, books, and other materials which explain the entrance requirements, course of study, and areas of concentration. Make sure that you examine the scholarship information and financial requirements. Select three of four schools where you believe acceptance is possible and contact them for further information.

After you have studied the entrance requirements and the courses necessary, select those high school subjects which will prepare you for entrance. You should take courses that will give you insight into the work on the college level.

As you near the end of your academic career, contact the various firms and agencies which employ career environmentalists. State your qualifications and the contribution you believe you can make to their organization.

Materials:

Occupational information, college catalogs, reference books, interest and aptitude tests, interpretive information, high school schedules, local scholarship information and any other materials that might be valuable to the students.

References:

Bennett, Seashore, Wesman, Differential Aptitude Test, The Psychological Corporation, New York, NY

Strong, Campbell, Berdie, Clark, Strong Vocational Interest Blank, Psychological Corporation, New York, NY

_____, Career Education in the Environment, Olympus Research Corporation, Superintendent of Documents, U.S. Printing Office, Washington, D.C.

_____, Career Opportunities Ecology, Conservation and Environment Control, J.G. Ferguson Publishing Co.

_____, Catalog, Environmental Outdoor Education Materials Co., Dowling, Michigan 49050

_____, Dictionary of Occupational Titles, Volumes I and II, U.S. Department of Labor, Superintendent of Documents, U.S. Government Printing Service, Washington, D.C.

_____, Opportunities in Environmental Careers, Universal Publishing and Distributing Corporation, New York, NY

Senior High
Special Education

Submitted by Jane Crumley

HYGIENE-FEMALE

Behavioral Objectives:

1. The student will be able to explain how to take a bath or shower.
2. The student will be able to explain methods of shampooing hair.
3. The student will be able to demonstrate knowledge of fingernail care.
4. The student will be able to demonstrate knowledge of the changing and disposing of sanitary pads properly.
5. The student will become familiar with tampons.
6. The student will be able to explain the meaning of V.D.
7. The student will be able to state that V.D. is contracted by sexual contact.
8. The student will be able to explain the fact that sexual contact is necessary to contract V.D.

Directions to the teacher:

The instructor should be able to conduct this class discussion without embarrassment and cope with questions of an elementary nature.

Materials:

Soap, shampoo, and water; emery boards, cuticle remover, orange stick and fingernail brush; sanitary pads, belts, and tampons.

Visual aids showing menstration and V.D. would be helpful.

Senior High
Special Education

Submitted by Val Crumley

FROGS

Behavioral Objectives:

1. The student will be able to identify a frog as opposed to a toad.
2. The student will be able to describe the environment of a frog.
3. The student will be able to list foods eaten by a frog.
4. The student will be able to describe ways frogs improve the environment.
5. The student will be able to demonstrate that a frog is harmless by handling.
6. The student will be able to explain the importance of water to a frog.
7. The student will be able to demonstrate protective handling of a frog.

Directions to the teacher:

It is important to explain to all students that frogs are not the cause of warts.

Directions to the students:

Each student should be allowed to handle a frog, if he desires.

Comments:

Teach the students that frogs are harmless and that they make good pets. Frogs can be trained for jumping contests.

Senior High
Special Education

Submitted by Val Crumley

PETS

Behavioral Objectives:

1. The student will be able to describe a pet.
2. The student will be able to name which animals make good pets.
3. The student will be able to name which birds make good pets.
4. The student will be able to select correct food for specific pets.
5. The student will be able to explain good care for pets.
6. The student will be able to list reasons for feeding pets.
7. The student will be able to list reasons for watering pets.
8. The student will be able to show concern for the safety of the animal when handling pets.

Directions to the teacher:

The student should be able to give one good response to each objective. Because of the incompatability of some animals and disease factors, the animals should be located at various points in the classroom. Be sure the room is well ventilated. Do not let students handle pets excessively. Take one of the pets into the classroom each week and discuss its care. Two students should work together when caring for pets to stimulate social growth of the students.

Directions to the students:

Keep away from cages and pets unless the teacher has given permission to handle or feed.

Materials:

Small animals: hamsters, white rats, puppies, kittens, etc. A wire cage or appropriate housing for the pets.
Filmstrips, films, and slides to help with class preparation.

Senior High
Special Education

Submitted by Johanne Guyton

DAY AND NIGHT

Behavioral Objectives:

1. The student will be able to state with accuracy the difference between day and night when shown sample pictures.
2. The student will be able to identify with accuracy the time of day by using the terms, day or night.
3. The student will be able to explain that the sun shines during the day and moon and stars shine at night although not always visible.
4. The student will be able to state that during the day, the sun furnishes light and during the night, people rely on electrical power.
5. The student will be able to explain the difference between day and night.
6. The student will be able to display knowledge and proper usage of the words: day, morning, afternoon, noon, night, and evening.
7. The student will be able to list four activities that take place during the day and four activities at night.
8. The student will be able to explain that rotation of the earth accounts for the continual changing from day to night.
9. The student will be able to explain that the sun shines with its own energy and that the moon reflects the light of the sun.
10. The student will be able to display manners in taking turns in talking and responding.

Directions to the teacher:

Lessons will be given in a group situation, perferably around a table. Include the less verbal students in the discussion and leave openings for questions. Maintain an open and approving attitude to encourage contributions from reluctant pupils.

Directions to the students:

Let's get in our group. Today we are going to talk about day and night. Usual group discussion rules will apply. (Listen carefully. Raise your hand. Stick to the point. Don't clam up. Work together. From the D.U. S.O. series, American Guidance Services.)

I will show you a series of pictures. I want you each to select one and tell us the time of day and what you can do then.

Materials:

Globe and various pictures of day and night situations.

Comments:

Any films, filmstrips or records on the subject would be most helpful.

Senior High
Special Education

Submitted by Johanne Guyton

THE SEASONS

Behavioral Objectives:

1. The student will be able to list the four seasons accurately.
2. The student will be able to answer accurately that there are four seasons.
3. The student will be able to recognize the words: fall, winter, spring, and summer.
4. The student will be able to respond that the months of June, July, and August are summer months.
5. The student will be able to reply that the months of September, October and November are fall months.
6. The student will be able to answer that the months of December, January and February are winter months.
7. The student will be able to respond that the months of March, April, and May are spring months.
8. The student will be able to describe various types of clothing worn in different seasons.
9. The student will be able to name the seasons when shown pictures of seasonal scenes with 90% accuracy.
10. The student will be able to describe weather and temperature conditions commonly associated with the seasons.
11. The student will be able to list different outdoor and recreational activities commonly associated with the seasons.
12. The student will be able to state the condition of plants and vegetation during the seasons, i.e., leaves turn color in the fall, no greenry in winter, budding and greening in spring, and abundant growth in summer.
13. The student will be able to demonstrate an understanding of the concept that seasonal changes are due to the rotation of the earth and consequent positions of the sun in relation to the earth.
14. The student will be able to discuss in group situations the activities he enjoys in each season.

Directions to the teacher:

Group type teaching at a table is most effective. An approving and open attitude on the part of the teacher will encourage individuals to participate.

Directions to the students:

Today I would like to talk about the seasons. Who can name the seasons? How many seasons are there? Who can tell me . . . as related to the objectives.

Materials:

Picture cards, films, records, stories and games which are applicable.

Comments:

This unit is vastly expandable. Nature walks to observe weather and temperature conditions, animal and plant life are excellent supplementary activities.

Senior High
Speical Education

Submitted by Johanne Guyton

THE SUN

Behaviorial Objectives:

1. The student will be able to state that the sun is a star.
2. The student will be able to explain that when our part of the earth is turned toward the sun, it is day and when turned away, it is night.
3. The student will be able to explain that when the sun is shining most directly on the earth, it is spring or summer and that when the sun shines most directly on the other half of the earth, it is winter or fall.
4. The student will be able to state that the sun gives heat and light.
5. The student will be able to state 90% of the time that people are dependent upon the sun for life.
6. The student will be able to express an understanding that the earth could not exist without the sun.
7. The student will be able to explain 90% of the time that light and heat are needed for plant growth.
8. The student will be able to demonstrate an understanding that people are dependent upon the sun for plant and animal growth for consumption.
9. The student will be able to state with 75% accuracy that the moon does not shine with its own energy, but with the reflection of the sun.
10. The student will be able to listen and be attentive to the teacher 60% of the time.
11. The student will be able to cooperate with others in a group situation 90% of the time.
12. The student will be able to explain that the rotation of the earth accounts for the phenomena of sunrise and sunset.

Directions to the teacher:

This activity is to be taught in a group, preferably around a table. For maximum affect, groups of TMRs should be limited to not more than ten students per teacher/aide. To encourage participation and discussion, the teacher should maintain a warm, open, approving attitude.

Directions to the students:

Today we are going to discuss the sun and what it does for us. Who can tell me something about the sun? D.U.S.O. group rules will apply.

Materials:

Filmstrip, films, pictures, records, stories, etc., will be helpful.

Comments:

A nature walk to observe sunny days and plants growing could be helpful and enjoyable.

Senior High
Special Education

Submitted by Johanne Guyton

WEATHER

Behavioral Objectives:

1. The student will be able to list differnt types of weather and temperature conditon descriptions, i.e., sunny, stormy, snowy, cloudy, rainy, wind, warm, cool, hot, cold, very cold and very hot.
2. The student will be able to look out a window and give the correct description of the day's weather with 90% accuracy.
3. The student will be able to use the appropriate description of the day's temperature when asked for his observations with 90% accuracy.
4. The student will be able to identify the type of weather in various pictures depicting weather with 75% accuracy.
5. The student will be able to select and cut pictures from a magazine depicting four different types of weather.
6. The student, when given the weather conditions by the teacher, will be able to select the correct type of clothing from a set of Peabody Picture Cards.
7. The student will be able to select and dress a Peabody mannequin with the proper clothing for the weather as described by the teacher.
8. The student will be able to describe proper clothing to be worn for any type of weather when given weather and temperature conditions
9. The student will be able to demonstrate an understanding of weather and weather conditons by selecting and wearing the proper clothing for the type of weather.
10. The student will be able to demonstrate word recognition when given a list of twelve words with 50% accuracy.
11. The student will be able to discuss weather and temperature conditons with the teacher and peers in a group discussion
12. The student will be able to express knowledge of group discussion rules.
13. The student will be able to listen and be attentive to the teacher and peers when they are speaking 75% of the time.

Directions to the teacher:

A unit on weather and temperature is an excellent opportunity to monitor and teach students about proper dress. Group techniques should be used. The teacher should be supportive and encouraging.

Directions to the students:

Today we will talk about the weather. I want you to show me the correct picture when I name a type of weather. I want you to find several pictures of four different types of weather. I want you to dress _____(doll's name) for _____weather. Look out the window and tell me what kind of weather you see. What is it like outside? What is the temperature?

Materials:

Peabody Kit Level I, magazines, scissors, films, records and stories.

Comments:

Weather study can easily be incorporated into your opening exercises every day.